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ABSTRACT

This manual is intended to give novice and veteran teachers a basis for inquiry within their classrooms. The following sections are intended to guide the reader through an introduction to practicing inquiry within the classroom: Philosophical Overview, Historical Overview, Use in the Classroom, How to Establish Inquiry in Your Classroom, and Practical Applications. The sections are designed to fulfill the reader's needs in developing knowledge, experience, and then belief in this method. The final section of the manual has as its purpose the exhibition of the potential of inquiry in the lives of classroom students. Eight sample lesson plans and descriptions describing seven techniques are included. Thirteen references are attached. (MG)

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THE ART OF INQUIRY IN THE CLASSROOM

A MANUAL FOR TEACHING

by

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The purpose which runs through and strengths all other educational purposes--the common thread of education--is the development of the ability to think.

--Educational Policies Commission, 1961

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INTRODUCTION

If there are to be any "first thoughts" established by this inquiry project, it should be that children are inclined to want to be active participants in their own learning process; they are intrinsically active searchers and inquirers as opposed to being docile acceptors of knowledge. This is true inside school as well as outside (Hudgins, 1977). We believe that with the cultivation of the inquiry method of learning and teaching (yes, teachers can and do learn right along with the students), children can redevelop the urge to learn which was natural to them at birth. The inquiry process is a tool that children will find necessary and useful in all phases of their lives, especially in the areas of problem solving and decision making.

I hear and I forget
I see and I remember
I do and I understand.

--Chinese proverb

The now very-family Chinese proverb echoes across the educational scene as never before. With increased emphasis on accountability for teachers and schools, increased demand from businesses and global publication of school test results makes getting to kids to understand seems more important now than ever before. The question still seems to remain--how?

How to get kids to understand more of their work and to become involved to the point of growing into lifelong learners is the goal, perhaps even the dream, of many teachers. This manual does not present any secret formula or magic solution to get the students of your class involved more and understanding more of the content of your class. It instead draws upon a naturally occurring activity within most students and adults. It is simply a curiosity about something of their interest. Add to that the thought that the value of something is not just getting it--but carrying it (Beyer, 1972)--and the basis for an inquiry session is established.

This manual is intended to give to the notice and veteran teacher a basis for inquiry within your classroom. The sections - **Philosophical Overview, Historical Overview, Use in the Classroom, How to Establish Inquiry in Your Classroom,** and **Practical Applications** - are intended to guide the reader through an introduction to practicing

inquiry within the classroom. Not all sections are intended for study. Rather, the sections are designed to fulfill the reader's needs as one develops, perhaps as we did, some knowledge, some experience, and then belief in this method. The final section has as its purpose the exhibition of the potential of Inquiry in the lives of the classroom student.

As you read through the manual and perhaps even try some of the activities, remember this important point: This is called the art of inquiry in the classroom. As an art, the boundaries of its shape and the parameters of its definition are designed by those who experience it and teach it. Certainly there are limitations set to insure that it continues to be inquiry. Yet to establish hard-and-fast procedural rules eliminates the vitality which exists in classrooms where the teacher is the artist. As you, the artist, experiments, a form and shape will emerge for your particular classroom and class.

We hope you enjoy your journey into Inquiry.

Don Andre
Tom Dewing
Ray Jamiolkowski

June, 1989

THE PHILOSOPHY BEHIND INQUIRY

Most educators would agree that the central purpose of schooling is to prepare the students for the future. We have moved from an industrial society to an information-based society which is demanding more every day upon the worker and upon the society itself. These demands call for an increased amount of ability to solve problems and to reason through situations yet developed. As countless readings of the future state, not only are there situations yet developed, which will call upon thinkers to solve them, but many of the various jobs our youth of today will engage in have yet to be developed.

If the school's mission is to prepare the students for the future and the future is dependent upon workers who can think and reason, then teaching students to think becomes the central purpose of schooling. As Beyer (1972) states, "Clearly, instruction and experience in thinking constitute, or ought to constitute, two of the most important goals of formal schooling in our nation today" (p. 92).

To think and to reason through problems becomes the instructional goal for every student who is to take part in the continued development and growth to reach a more fulfilling life (Beyer, 1972). Yet, this type of power will not, indeed cannot, exist on its own accord. This type of ability must be nurtured and given life by the factors contributing to a child's cognitive growth.

The greatest factor is the teacher. No matter how many great kits, texts or instructional packets there are in schools, it is the teacher who determines, consciously or unconsciously, the kind of learning that is taking place within the classroom. Is it meant to be drill and practice on a long array of questions, or will the students be creating the questions and the process to arrive at the answers?

A classroom in which new information is viewed as a treasure to capture is going to be a classroom in which students are actively engaged in the process. This process is seeing a problem, hunting for the solution and upon discovering it, creating new avenues of searching for other related questions.

So what is this process that we call inquiry? Where did it come from? The process is as old as man himself. The only attribute needed is curiosity. Man has always been a curious creature, trying to learn and know that which is not known. As Socrates said to Menon:

> . . . but one thing I would fight for to the end, both in word and deed if I were able--that if we believed that we must try to find out what is not known, we should be better and braver and less idle than if we believed that what we do not know it is impossible to find out and that we need not even try. (p. 129)

Unfortunately though, as curious as many children are, they lack direction and organization in their approach to a systematic method of inquiring.

The first major study for the use of inquiry in the classroom was done in the post-Sputnik years by J. Richard Suchman at the University of Illinois. The study was called the Inquiry Training Program. Suchman's emphasis was on arousing the child's curiosity with regard to the principles of science. In order to have students learn any scientific phenomenon, the teacher of inquiry has to instruct the children in asking disciplined questions and finding ways to accomplish this. This is one of the critical points in Dr. Suchman's Inquiry Training Program. **This method aids in building the child's skill in observation development of good question formation as well as intellectual inquiry.**

Suchman found through his studies that the formation of quality questions by children, even of superior intellects, is a difficult task.

Having the teacher as well as the students spend too much time on materials and methods of the hands-on part of the science curriculum keeps them off track and therefore diminishes both the quality and quantity of questions that would otherwise be of great value (Hudgins, 1977). Suchman (1962) emphasizes the use of questions that have only a "yes" or "no" answer. He set the goal

> . . . to develop the cognitive skills of searching and data processing and the concepts of logic and causality that would enable the individual child to inquiry autonomously and productively; to give the children a new approach to learning by which

> they would build concepts through analysis of concrete episodes and the discovery of relationships between variables; and to capitalize on two intrinsic sources of motivation--the rewarding experience of discovery and the excitement inherent in autonomous search and problem solving. (p. 24)

Suchman, as well as other followers of the inquiry method at the time, felt that a child's natural curiosity and knowledge base could enable the child, through a teacher's guidance, to construct the events or variables necessary to develop conceptual frameworks for the material being learner. This inquiry teaching, beyond any other type of strategy, "enables a teacher to aid student invention and development of concepts while simultaneously helping students to use concepts to accomplish other cognitive and affective learning goals" (Beyer, 1972, p. 145).

Inquiry learning draws from the understanding that concepts are the base of all future learning and these concepts make all other learning possible. Without the categorizing structure of conceptual learning, all the facts and masses of information that a child has to absorb in order to become a fulfilled adult becomes awash in the sea of misunderstanding. Conceptual teaching allows the student to make sense of the information. By forming categories for information, the student has an area for the new information to be placed. If a bit of new information arrives and there is no location for it in the child's conceptual framework, then a new category can be developed, drawing from the

previously established material.

Inquiry learning relies on this established methodology in that the student, while pursuing an investigation, draws upon previously learned and developed concepts as his/her new understanding unfolds in the inquiry. As Barry Beyer (1972) states:

> Inquiry is a learner-centered process requiring the active cognitive and affective involvement of each individual. Inquiry is a self-directed rational strategy for making sense out of an experience. It represents a way of thinking that requires the systematic manipulation of information to find a supportable answer to a problem or a question. (p. 78)

The student, throughout an inquiry lesson, discovers the path to formulate the answer to a particular problem or question. Discovery is reorganizing the information or data a person has and changing it into some new form which satisfies a given condition (Bruner, 1961). Through this reorganizing of known data, and the acquiring of new data, the student proceeds through an inquiry much like a detective proceeds through a mystery. Clues are received and dealt with in an organized, systematic manner. Guesses as to the cause of the crime are made and sometimes discarded as new evidence becomes available. Then, after all the needed evidence has been gathered and the data applied to the remaining hypotheses, the detective produces what he/she believes to be the formed conclusion.

As in solving as mystery, the process in an inquiry is the very heart of the methodology (Beyer, 1972). The

process draws from the scientific procedure in that it is logical, determined and defined. It draws from the psychology of child learning in that it becomes leveled and cognitively balanced to the needs of the student. It draws from current acceptable teaching practice in that it is child-centered, cognitively provoking, and provides the student with strategic avenues for further learning.

Besides just accomplishing the instructional objective for a particular day, the benefits of inquiry learning go much deeper. There is the intellectual potency which develops by demanding the student to be a doer in his/her educational endeavors instead of the simple receivers. By actively participating in the process of discovery and formulating the answer to a problem, the student begins to unleash that potential for deeper and lasting thoughtful thinking.

A second benefit is a change from extrinsic reward to an intrinsic reward. During the inquiry process, there are hurdles which are met and crossed by the student's own ambition. A letter grade of "A" at the close of the lesson, as in so many other school subjects, stresses to the student that he/she has succeeded and that there is no more. It prescribes to the student the belief that once there is that grade, then the subject is closed and it is time to move on to the next. In inquiry, the accomplishment is within the children themselves as the deep inner feeling of success at

mastering a particular aspect has been seen. What child, once a certain difficult puzzle has been solved, does not wish for more and, once the level of puzzle has been seen, does not wish for greater levels to accomplish? No "A" could equal the feeling a child has.

Lastly, the benefit to inquiry is in the development of the student's ability at creating his/her cognitive maps for future learning. The old saying is: "Give a starving man a fish he will eat for one day; teach him to fish and he will eat for a lifetime." This holds true in inquiry learning. The student can never possibly learn all that is needed in the way of facts for a lifetime while at school for a few hours a day. Instead, it is the job of the school to help the child develop the means of learning. The inquiry process does that (Bruner, 1961).

HISTORICAL OVERVIEW

Somewhere between the thought that the mind is a muscle and the true art of discovery learning lies the historical foundation for the movement of utilizing inquiry in the classroom.

The ancient Greeks were well known for their desire for the truth and the application of knowledge. The Greeks made a distinction between the pure type of knowledge and the applied type, oftentimes as related to their sciences. Since their desire increased and caused the cognitive lust for knowing "why" as well as just knowing, the Greeks tended toward demonstration and observation while learning.

During the Middle Ages, there came upon the scene a revised form of educational inquiry. This was based on the Roman Catholic use of Aristotelian philosophy and the strict moral, religious, and ethical teachings of the church. There were numerous great teachers during this period, two of which had their own inquiry-directed style. These men were Peter Abelard and, later, St. Thomas Aquinas.

The development of the American school led from a more functional need. How are we to prepare these students fort the world in which they are to live? In the early part of the country's history, the preparation for reading of the Bible became a primary concern. Developing a thinking individual stood back from the belief that, like any muscle, the mind needed to be exercised to improve.

After a century of following certain teaching beliefs from Colonial times through the late 1800s, a change came over the educational system of the United States. Authors and historians have wrestled with a definition of the period, commonly known as the Progressive Period. It is not something which was started, but was an answer to a call which developed over half a century of American education. This call came from the movement called Progressivism which was a label "for a cluster of social, economic, educational and political attitudes based on the belief that America was in a crisis" (Ripley, 1980, p. 171).

Progressive Education was an answer and a road to the call for reform. The reformers saw the possibility of changes taking place in society through knowledge and that the knowledge was coming from the schools. It emerged when it did since all the reformers and their suggested reformers came together with such leaders as Roosevelt, Wilson, Dewey, and Riss.

Progressive Education, as Rippa (1980) stated, became more closely associated with the general movement of progressing. It was hopeful in its approach that the schools themselves would become more closely tied with life. As Rippa (1980) quotes Dewey, "A school that is tied with life sends out into life men and women intelligent in the activities in which they are to participate" (pp. 210-211).

Yet for the inquirer, this movement provided the

beginning of moving the school from a "gym" to exercise the mind, to a guiding institution where the mind is developed, a place where the facilities which are provided allow the student to engage in the activity of life through situations which provide the close approximation to what would be encountered in the real world.

USE IN THE CLASSROOM

Inquiry teaching is not the only strategy you will need to have your students become prepared for the future and to reach your instructional objectives. It is, however, a powerful directive force which can excite your students toward a lesson, stimulate their thinking, and provide a foundation for future problem solving.

These could be the descriptions of any good classroom. Any classroom which frees the mind to look at new ways of knowing can help establish the base for lifelong learning. It is the process the student becomes involved in and, in turn, the process which makes the student grow.

In order for this change to come about and the student and teacher alike to reach the educational goal, three aspects must come into line: the classroom, the teacher, and the student. With the first, there must be an open climate within the classroom for discussion and experimenting with ideas. This experimenting with ideas is not the cookbook type of experimenting seen with many textbooks. It is, rather, a true exploration into sometimes uncharted areas. It must be viewed as a journey, a questing in which risks must be taken. It is seen within this classroom that what were formerly final concepts learned and tucked away become not the goals, but "the tools for learning" (Beyer, 1972).

The second major component is the teacher. "During

all phases the teacher is counselor to inquiry, helping the students clarify and imply" (Weil & Joyce, 1978, p. 168). A few years ago, the feeling was that the teacher should move from supreme director to facilitator of the classroom, a person who opens the door and proceeds with the students on an adventure in learning. The teacher then must be one who can allow risk taking and exploration, knowing that the final evidence will be growth.

Lastly, the student adds to the inquiry process as the final major component. "Discovery," says Bruner (1961), "like surprise, favors a well-prepared mind." The student must be the one who gathers the data provided and utilizes it with the assistance of the facilitator in the proper classroom climate.

Massialas and Cox (1966), primarily from Suchman's work, identified five phases of the inquiry process. These phases were identified as: (1) Orientation, (2) Hypothesis construction, (3) Defining hypothesis, (4) Evidencing, and (5) Generalizing.

During orientation, the student is "sensitized" to the problem (Massialas & Cox, 1966). A problem or situation is presented to the student for questioning and reflection. This stage is important as it prepares the child for the furthering of inquiry. It also is important since the problem or question must be so structured as to excite and deepen the interest to go further. "Nothing stifles

learning in a sequence of inquiry teaching units any faster than starting off the same way each time" (Beyer, 1972, p. 189).

After the problem is presented, the student then enters the second phase--the construction of the hypothesis. While in this stage, the student brings together the existing conceptual bases that he/she has to form newer conceptual schemes which will provide answers to the problem. Through this and the fourth stage is where the teacher must further assist the students by helping them to assemble the evidence, arrange and analyze the available information (Beyer, 1979).

While the veteran inquirer might be able to form direct hypotheses, it is in the third stage that the neophyte needs the greatest amount of direction. In this stage, the hypotheses, those statements which give a base plan of action during the inquiry, need better defining and clarification. The new inquirer will need direction.

Evidence gathering is the fourth stage. During this phase, the student goes on a fact-finding mission. It is with this stage that the differences in library research and library fact-gathering become evident. The library becomes an opening to a greater world through inquiry. No longer satisfied with filling pages for facts, the student searches and discovers more through inquiry. Teachers also provide information.

In the last stage, the student generalizes the information and produces a statement of conclusion. Often the statement might not completely satisfy the given situation. Here is evidence that like life itself, the process of inquiry doesn't end, but develops other questions for further searching.

DEVELOPING AN INQUIRY LESSON

> I do not know what I may appear to the world but to myself I seem to have been only like a boy playing on the seashore and diverting myself now and then finding a smooth pebble or a prettier shell than ordinary whilst the great ocean of truth lay all undiscovered before me.
>
> --Isaac Newton

Here is the given: We have elementary schools full of kids. All the subjects, especially science and social studies, have to be taught. By what means are we going to do this? Are we going to use the teacher only? Are we going to use the kits and the worksheets? Are we going to use the textbook, rote learning, or process learning?

The question in each teacher's mind that has to be addressed is: Do you want the children to learn how to be taught or do you want them to learn how to learn? There it is.

We all have for the most part learned how to be taught. We went to school where we read and were questioned about a chapter in history or science. The questions usually were a matter of simple recall. For example: "Name three battles that were decisive for the American Army in World War I." "Name five major parts of a cell." With this sort of teaching-learning, the students saw filmstrips or movies. The teachers used overhead projectors, worksheets, and the chalkboards to illustrate and emphasize important points. We then were told to "study" for the test. The test covered

those points gone over in class--that is, the simple recall. How many facts can you remember? This is not necessarily a detrimental method of teaching. Teachers should include this method in their repertoire. It should not, however, be used to the exclusion of all other methods.

So how do we teach children to learn? We, as educators, need to direct our students to the vital point. This point is that they have their own highly advanced portable computers with them and they work very well if given the opportunity. So let's find some opportunities for the students in the classroom.

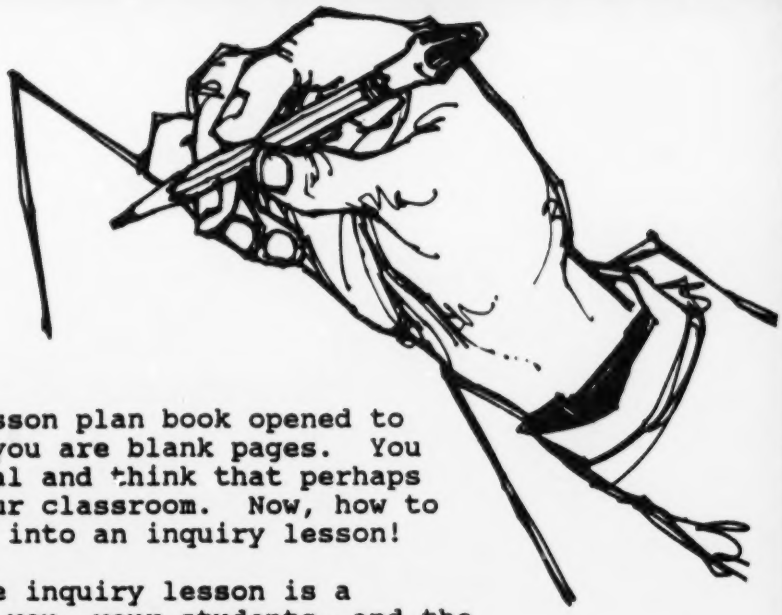
One of the findings that Suchman's Inquiry Training Project reveals is that the use of inquiry is most effective when used in conjunction with subject areas, particularly in science, as opposed to being taught in isolation. We believe it is true that the use of inquiry is best used in the content areas. However, it is much easier to train children, particularly younger children, the proper questioning methods in isolation. A simple way to do this is to play a game of 20 questions. An example follows:

Place an object in a small decorated box (a shoe box does nicely). The box itself begins to create a sense of curiosity. The object can be just about anything that physically fits. The objective of these exercises is to teach the students the type of questioning that scientists use--those questions that have "yes" or "no" answers. In

the first session, practice with something simple such as a ball. If the students fail the first time to discover the contents of the box, slowly peer into it and perhaps pull out a "hint" and try again. This type of exercise should be done on a consistent basis once or twice a week, especially in the primary grades. In the older grades, once a week is sufficient.

The higher the grade level, the more difficult the 20 questions can become. For instance, in kindergarten and first grade, objects placed in the curiosity box might be a rubber ball, a crayon, a hat, or a shoe. In second or third grade, the objects might be a pen, sunglasses, clothespin, or a sea shell. In fourth or fifth grade, the teacher might include a magnet, battery, a light bulb, a book, a particular fossil, a plant part, or a small flag from a particular country. The junior high school level might include a novel or a character from a novel, a particular thing located at or on a certain place (like a wolf sitting on a mountain top howling at the moon), or a yacht racing in America's Cup finals. The ideas here are to challenge, ask curious questions, and, at the same time, to have fun.

WORKBOOK



There it faces you. The lesson plan book opened to next week. All that faces you are blank pages. You have read through this manual and think that perhaps it could do some good in your classroom. Now, how to transform those blank pages into an inquiry lesson!

As you can guess by now, the inquiry lesson is a dynamic interaction between you, your students, and the problem to be solved. There are no exact, specified, perfected steps which will fit prior to the lesson. After all, this is called the "art of inquiry in the classroom" which means there must be some artistic eclecticism along the way. That pathway of perfection develops with use.

The purpose of this workbook is to help guide your planning prior to, along the way, and in retrospect as you plan for the next session.

SELECTING THE TOPIC

Is this to be a review of a concept or a major lesson?

If it is a review, what areas need concentrated review?

_____

If it is a major lesson, what are three major concepts which need to be taught?

_____

_____

_____

Select one of the above and write it here:_____

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List attributes of the concept:

_____

_____

_____

_____

_____

If you are preparing a "brief "warm-up" style inquiry problem, which of the attributes of the concept have double meanings, can be placed in other context settings, or are usually associated with other situations?

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If this is a major lesson, look at the list of attributes of the major concept. Put these in order of difficulty (in your opinion) for students you are working with to understand.

_____

_____

_____

_____

_____

In the lesson, these will be given to the students as they progress through the inquiry. How will these be given to them?

Through a story_____

By pictorial clues_____

By physical objects_____

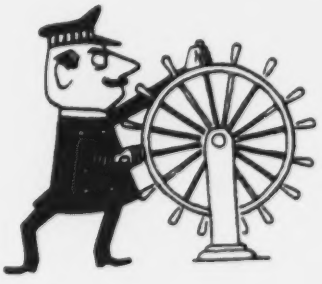
Other_____

How will you have students generate date and organize the data?

Doing a KWL_____

Divide into compartments (a box, charts, sections_____

Brainstorm as a class_____



What will be your role?

Story teller_____

Moderator_____

Special guest_____

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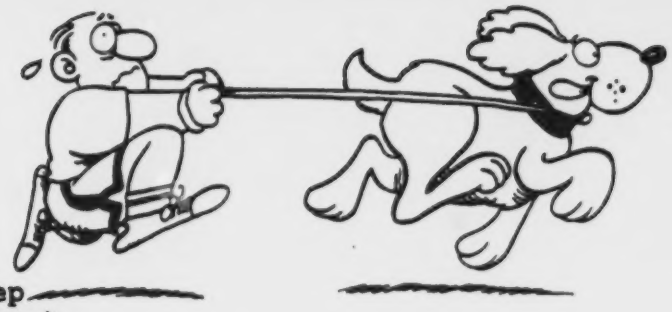

MAINTAINING MOMENTUM

The balance here is to keep the enthusiasm going "without letting the dog take the master for a walk."

At what points will you intervene?

_____

_____

_____

What is your role after the process has begun?

_____

_____

FOR NEXT TIME ...

What were three good things about the lesson or activity?

_____

_____

_____

What areas need improvement?

_____

_____

_____

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SITUATION

DATA

HYPOTHESES

TESTS

REVIEW

PRACTICAL APPLICATIONS

SAMPLE LESSONS

CONTENT AREA - Any

GRADE LEVEL - 1-2

INSTRUCTIONAL OBJECTIVE - To teach primary children the process/method of asking questions with "yes" and "no" answers.

MATERIALS -

1. Any kind of box with a top. A shoe box (decorated or not) is ideal.

2. Any simple object.

LESSON DESCRIPTION - Any simple object will do. For the sake of this example, use an ordinary green maple tree leaf. Place it in the box out of view of the students. It is important in this lesson that the students learn that only "yes" and "no" answers will be given to their questions.

Teacher: So here it is, class, the Mystery Box. First look at its size. This is an important hint to what might be inside it. Keep that in mind. Let's start the questioning and remember, only questions that have a "yes" or "no" answer.

Sue?

Sue: Is it big or small?

Teacher: Yes. Remember, only questions that have a "yes" or "no" answer.

Sue: Is it big?

Teacher: No.

Billy: Is it small?

Teacher: Yes.

Jean: Is it heavy?

Teacher: No.

Sara: Is it paper?

Teacher: No.

Jimmy: Can you make something out of it?

Teacher: Yes.

Donna: Can you write on it?

Teacher: Yes.

Darren: Is it a sheet of paper (smiling and thinking that he got it)?

Teacher: No (disappointment).

Becky: What color is it?

Teacher: Yes (only "yes" or "no" answers).

Sue: Is it white?

Teacher: No.

After that, there was a minute or so that elapsed with no questions, which can seem like an eternity, so I gave them a hint. I asked them if it would be important that what was in the box was living.

Jacob: Is it alive?

Teacher: No.

Katie: Was it alive?

Teacher: Yes.

Billy: Is it a dead mouse?

Teacher: No.

Mary: Is it an animal?

Teacher: No.

Laura: Did it used to be part of an animal?

Teacher: No.

Justin: Did it used to be part of a plant?

Teacher: Yes.

Justin, Sue, and Katie: Is it a piece of wood?

Teacher: No.

Mark: Is it green?

Teacher: Yes.

Mark, Sue, Katie, and Justin: Is it a leaf?

Teacher: Yes!

CONTENT AREA - Any

GRADE LEVEL - 1-5

INSTRUCTIONAL OBJECTIVE - To introduce children to the process/method of inquiry.

MATERIALS - Paper, pen, or chalkboard and chalk

LESSON DESCRIPTION - Teacher tells the students that they are going to play a guessing game. The teacher explains that this game is different in that they want to guess the answer in as few guesses as possible. The teacher explains that he/she is thinking of a number between 1 and 50. What is the number?

Teacher: How many possible guesses could you make before you came up with the correct one?

Child: 50!

Teacher: That's right. Today we are going to learn a way to get the answer in fewer guesses. Let's begin by looking at what we know about the numbers. [Teacher then puts up all the numbers between 1 and 50.]

Children: Some are odd. Some have single digits. Some are ending with a 5, 6, etc.

Teacher: Good job. Now this activity is called INQUIRY. In inquiry, it is like shooting at a target. You could just shoot all over the place and hope to get a bull's eye. Or you could aim, shoot, and adjust your shooting for the next shot. That is what you do in INQUIRY. We aim with our questions. You are going to ask me questions about the number that I am thinking about in which I can only say "yes" or "no" to in response. Think about how to aim more carefully, getting closer each time.

Child: Is it an odd number?

Teacher: Yes. Good question in that it eliminated 25 possible guesses.

Child: Is it higher than 40?

Teacher: No. Remember to give questions which get rid of as many possible guesses. That was good in that it eliminated 10 possible choices.

Child: Is it higher than 30?

Teacher: Yes! Now you know it is between 30 and 40.

The lesson continues as the students eliminate possible numbers. The important thing is not that they get the answer but that they are learning the process of seeing a situation, looking at what they know, organizing it, and then testing their guesses. Even if they do not come up with the answer or a possible answer right away, the students continue to build an understanding of searching and discovering.

CONTENT AREA - Language Arts

GRADE LEVEL - 1-2

INSTRUCTIONAL OBJECTIVE - To have an understanding of the short vowel sounds.

MATERIALS - None.

LESSON DESCRIPTION - Write the following poem on the board. Read the poem to the students and read it with them.

Ben was a cat and he was fat
And he loved to run in the mud
But when he did
He fell and slid
And went down in the mud with a thud.

Children should ask questions that can be answered only with a "yes" or "no" answer. There are several ways to approach this activity. It can be used as an introduction to short vowel sounds. It can be used to identify various short vowel sounds or it can be used as a review for short vowel sounds. A sample lesson for short vowel identification could go something like this:

Teacher: Here is a little poem that will help us with our reading lesson today. Remember, you may only ask questions that have an answer of "yes" or "no," just like we did with the mystery box. OK, let's begin.

Child: Is it a poem in our reading book?

Teacher: No.

Child: Is it a story about a cat?

Teacher: No.

Child: Is our story going to have a poem in it?

Teacher: No.

Child: Will this poem help us to read the story?

Teacher: Yes.

Child: Could you give us a hint?

Teacher: Yes (read, with emphasis on the short sounds).

Child: Does the poem have short vowel sounds?

Teacher: Yes.

Child: Is there more than one word with short vowel sounds?

Teacher: Yes.

Child: Is one of them Ben?

Teacher: Yes.

CONTENT AREA - Science

GRADE LEVEL - 1-2 Primary

INSTRUCTIONAL OBJECTIVE - To have students discover the identity of an unknown substance.

MATERIALS -

A large amount of rock candy, bowl, water, towel, hammer, a decorated shoe box (curiosity box), and a magnifying glass.

LESSON DESCRIPTION -

For this lesson, it will be necessary for the teacher to do some pretending as well as creative acting. The opening monologue can go something like this:

(Clutching the curiosity box closely). I received this present, which I will show you in a moment, from an old long-time friend of mine. He is a sea captain. He travels all over the world. While he was at one particular place, he found these beautiful rocks. He knows that I like to collect such curiosities so he sent them to me. They are beautiful. Oh, I'm sorry, would you like to see them? [In a showy and exaggerated manner, carefully using a soft cloth or tissue, take one out. Briefly hold it out for all to see. After you are sure that everyone has seen it, carefully place it back in the box.] Captain Tom did not know just what these pretty rocks were. That's why he sent them to me. We are going to try to discover what these are. Let's gather around the chalkboard. We can make a list of all the things we KNOW, things we THINK we know, and things we NEED to know. Let's see how this will turn out.

WHAT WE KNOW	WHAT WE THINK WE KNOW	WHAT WE NEED TO KNOW

Remove some other samples and pass a few around the class so that the students may hold and feel the sample. They can use magnifying glasses. Encourage the children to use their senses (except taste--they should never TASTE an unknown substance). Begin to fill out the chart. Do not accept "vagaries" like "weird" or "strange." Make them be specific. Encourage the students to ask questions from their

observations. Pique their interest and their curiosities by asking several open-ended questions, questions such as "This looks like a ..."

After the charts have been completed, the questioning should not end. Even if a child gives the correct response, keep going and get as many responses as possible. When the responses begin to go thin, do an experiment. Ask the students what they think will happen if you hit this rock with a hammer. Write some predictions from the students on the board. Cover a sample of rocks with a cloth and hit it a few times. What happens? Discuss it. Using the same process, place a rock or two into a beaker of water. Observe it and discuss predictions and results. Do rocks dissolve in water? If not, what could this be?

CONTENT AREA - Social Studies

GRADE LEVEL - Primary

INSTRUCTIONS - To have students become familiar with uses and needs of electricity in their homes.

MATERIALS - Curiosity box and electric plug.

LESSON DESCRIPTION -

This lesson is based on the curiosity box. The lesson can begin by the teacher saying, "We are going to discover some things about our school and especially about our home. What I have in the curiosity box is a piece of that particular thing." Again, as with the other activities, the questions that the kids ask must be of a "yes" or "no" nature. In this activity, it would be advantageous for the activity to give hints.

An example of the way the lesson could go with a certain set of questions follows:

Teacher: The curiosity box contains an object that can be found in your home or at school.

Student: Is it something that you can drink out of?

Teacher: No.

Student: Is it a book?

Teacher: No.

Student: Can it be found in the classroom?

Teacher: Yes.

Student: Is it a closet?

Teacher: No.

Student: Is it a chair?

Teacher: No.

At about this point, give the students a hint. The clue can be either verbal or a visual.

CONTENT AREA - Science Botany

GRADE LEVEL - 6-8

INSTRUCTIONAL OBJECTIVE - To introduce students to the study of plants.

MATERIALS - The following specimens should be at each station (if real specimens can not be found, a picture will do):

Station 1: oak, birch, apple, black walnut, grass, white pine needles, and maple leaves.

Station 2: corn, pumpkin, maple, cherry, dandelion, raspberry, watermelon, tomato, thistle, and pine seeds.

Station 3: bracket fungi, moss, lichen, algae, and mold.

Station 4: thyme, carrot, garlic, onion, grass, sage, pea plant, corn, marigold and nasturtium.

Station 5: part of a tree or two showing ring formation clearly.

LESSON DESCRIPTION -

This activity can be done either indoors or outdoors. Either way, however, the stations and the specimens should be set up and prepared in advance. This activity will take a while, so allow plenty of time. It does not have to be finished in one day. The activity can be spread out a little each day or whatever works best.

There will be a great number of books needed for the stations. The teacher should go through in advance and choose the books. Do not be afraid of using high school science books. The teacher's main job, once the activity gets underway, is to be a resource person and give direction to avoid confusion.

For an average size class (20-25), there should be no more than five students to a station. This keeps the confusion down to a minimum and helping each other becomes easier and more enjoyable. There is no set order to the stations.

The students will need the following materials:

1. Both lined and unlined white paper, 8 1/2 x 11"

2. Two or three sharpened pencils with erasers

Introduce the lesson by telling this story:

You have been traveling in space for six years on a research study of interplanetary plants for the government. The ship's captain discovers that the ship is almost out of fuel and must land on the nearest planet or be lost in space forever. Off in the horizon a planet is sighted. That is where the ship will have to land. As the captain pilots the spacecraft in, the gyrostabilizer malfunctions and the pilot is forced to make a crash landing. Everybody is safe. There are no injuries. However, all of the food was destroyed. The ship itself is in bad shape and will need repair. There is plenty of water, though, and enough oxygen. There is also an extensive library on board that is still intact. Obviously you and the rest of the research team cannot stay on the ship forever. So you break up into groups to explore this planet. You notice that the planet has plants on it and with no other food, you must find out all you can about the plants, especially if they are edible. So, being research scientists and having plenty of books to do research, you set out ... REMEMBER, you have no food and if you don't find any in time, YOU WILL STARVE.

These samples were collected and brought back to the ship for identification.

CONTENT AREA - Science

GRADE LEVEL - 3-4

INSTRUCTIONAL OBJECTIVE - To have children learn about the properties of chemical changes.

MATERIALS - 10 jars (or beakers), distilled water and six objects--a penny, a nail, a dime, a piece of aluminum foil, a lead fishing weight, and zinc. Also, FOR TEACHERS USE ONLY--diluted HCL (Hydrochloric acid), salt water, and sugar.

LESSON DESCRIPTION -

The first part of this inquiry lesson should be by way of discussion. Do a semantic web on reactions. Center the discussion around the properties of attributes of reactions that the children discover. A sample of the semantic web can be found in the TECHNIQUES section of this manual. When the ideas begin to slow down, use rules for brainstorming. That is, have the students hitchhike on each other's ideas. For example, on the sample web the word "car" is used. What other vehicles are there? ACCEPT ALL ANSWERS. If a student's ideas seem too general or unjustifiably vague, have him/her explain his/her thoughts. (Frequently a student will use the word "weird." I do not accept this. I will ask him/her to define the word "weird" for me.) Make the children accountable for their own thoughts.

The next step is to bring out six beakers or jars. Fill each of them halfway with distilled water. Have the children predict what will happen when an object is placed in each. Have the students write down their predictions in a journal. This journal should be kept and written in every day (see TECHNIQUES section). The sample jars should be labeled both for the liquid and the object it contains. For example:

[pictures of jars]

Each day, detailed observations should be made as to what students perceive happening. Are there any color changes? Have their shapes changed?

The third part will occur more quickly and should be completely teacher-directed as the hydrochloric acid is dangerous. (PLEASE WEAR GOGGLES AND HAVE THE CHILDREN STAND BACK A SAFE DISTANCE.)

Each of the jars should contain about 200 ml of liquid. Have the jars labeled so only you, the teacher, is allowed to see. The jars should be labeled A-D, Point out to the children that each jar contains an odorless and colorless liquid. The students should have pencil and paper and be ready to make predictions and observations. Put a nail in jar A (water) and ask the students what happened. Do the same with a nail in each of jars B, C, and D. In jar B, have salt water. in jar C, have sugar water. In jar D, have diet Seven-Up. Then make sure the students take careful notes of all they see. These jars should be placed in a safe place away from the students. Again, as before, daily observations should be taken and noted in their journals. At the end of the week, refer back to the students' predictions and the records of observations. How do the notes compare with the information that was collected in the semantic web on the first day of the lesson?

They should also be able to construct a bar graph for each experiment illustrating the changes that have occurred. A different color for each material or liquid would be more attractive as well as more informative by way of identification. When the graph has been completed, discuss the possible solutions.

CONTENT AREA - Junior high school science or math

GRADE LEVEL - Junior high or high school

INSTRUCTIONAL OBJECTIVE - To determine the inner orbits of Mercury and "Venus through triangulation, much the same way as Johannes Kepler did.

MATERIALS - Pencil, paper, ruler, protractor, and compass.

LESSON DESCRIPTION - The lesson begins with a given situation to the students in the form of a story.

The problem: A few years ago, a group of students took a two-week trip to Europe. While in Britain, they got to explore a number of castles. They received a guided tour of Herstmonceaux Castle in East Sussex. This castle was built in 1441. It was originally owned by Roger de Fiennes. It now houses the Royal Observatory. A famous scientist once resided there. There has been an aura of mystery surrounding both the castle and the person. Andrew Lord Buckingham went into seclusion late in life and was never heard from again.

As with many guided tours, they are interesting but very tiring. James Tyrell, a member of the group, decided to sit and rest a while. He figured he could catch up to the rest of the group later. James found a comfortable-looking chair, sat down, and closed his eyes for what he thought was only a minute. He was startled awake by the last rays of the sun glimmering through an old stained glass window. His first impulse was to dash outside to see if he could find a way back to the hotel. There was something, however, that compelled him to stay where he was. He was filled with apprehension and yet at the same time an intense curiosity. He found himself gravitating toward an old dusty bookshelf. The waning sun made him realize that he was about to be engulfed in darkness. He reached in his pocket and found a book of matches. That and the discovery of some candles took care of the lighting problem. His attention was then drawn again to the bookshelf. The ages of dust could not hide the quality of the books. There was a great variety of subjects including Mathematics, Astronomy, Philosophy, Religion, and History. His eyes combed the shelves eager to see all. He examined row after row with intense delight. One book in particular caught his eye. It was no different than the others, brown with age, and covered with dust. He carefully blew the dust off to observe the title more closely. The binding read <u>Patterns in the Universe</u>. James looked where the author's name should have been but found only the initials "B.A."

Curiosity got the better of him. He gently pulled the book in order to remove it. Nothing happened. He pulled harder and as he did so, he felt the bookshelf move. He quickly got out of the way. Tyrell stood back and watched the shelf open wide enough for a man to walk through. Armed with his candle, he peered into the darkness of the next room. It appeared to be a combination library and laboratory. He walked in, carefully, so that his eyes could adjust to the darkness. There was an eeriness that pervaded the entire room. He noticed a table that had books on it as well as geometric figures. There were old paintings on the wall and a fireplace whose warmth could never have completely ridden the death-like chill of this room. He turned to continue his investigation when he tripped and fell to the floor. The candle went out. Fear gripped him momentarily. He began groping for the candle. His hand felt out a number of objects. They were hard and of differing shapes. One he felt had a smooth, curved surface. More of those geometric figures, he thought to himself.

After another minute of searching, he found the candle and without wasting any time pulled out his book of matches. He took a match and lit it. As he slowly brought it closer to the candle, he recoiled in terror! There, staring up at him was a human skull! He stared unbelievingly at the object long enough for the match to burn him. He dropped it and darkness once again reared its ugly head. He forced himself to remain calm. With cold, unsteady hands he managed to light another candle but to no avail. He could not take his eyes off of it. As he slowly rose to his feet, his eyes readjusted to the dimness and the whole scene unfolded before him. There was indeed a pile of bones and rags.

"Lord Buckingham, I presume?" James said in a voice belying his uneasiness.

He carefully set the candle on the desk. The top of the desk was empty, save for one sheet of parchment with writing on it, a quill laying on the parchment, a small bottle of ink long dried of its usefulness and a candle holder.

There was a poem written on the parchment. It is rewritten here for your observation, word for word:

Observations I've made
Of known planets and stars
Circles and Triangles
Mercury, Venus and Mars.

The sun at center
The earth one away
The orbits of three
Elude me today:

My time grows short
The candle, it wanes
The church will sequester
My work as profane.

So in secret I write
All that I've done
To shed some light
For generations to come.

Mercury
It's greatest--imparts at
  24 degrees no more

Venus
Will abate only
After 48 degrees
It will not wait

Mars

"He never did get a chance to finish it," thought James. He was so intrigued that he failed to hear the front door open. He was soon brought back to reality when in walked three men. He looked up with a start to find a police officer, the tour guide and his friend Thomas. After the initial surprise, James explained what had happened. Before leaving, he copied down the poem to work on later.

Can you find the orbits of Mercury and Venus with the information in the poem? It is not that hard. Here are the materials that you will need:

paper
protractor
compass
ruler
sharpened pencils

TECHNIQUES

No one procedure will work best for every inquiry. The following is offered as a resource of techniques to employ while doing a lesson.

SEMANTIC WEB

This is sometimes called a word web. In it, the purpose is to involve the student in making connections to that which is already known and the instructional objective of the lesson.

rust

The web is useful when the students reach a point in their development of ideas in which further thought seems impossible. For example, a short story has been given in which the clue to the answer is the term "home."

The man was afraid to go home because the man with the mask was there.

It seems that the students have exhausted all possible avenues in the quest for the solution. By doing a word web, more ideas surface as to the meaning and importance of the word "home." In this particular case, the word "home" can mean a place of residence, a feeling ... or the fourth base in a baseball diamond.

KWL

KWL stands for "What we KNOW, What we WANT to know, and what we LEARNED." It is a great beginning to many lessons in that it pulls from the student's prior knowledge and sets the formation of what is to come. In the inquiry lesson, it becomes important to have the students discover the solution using what they possess already. KWL can assist in doing that. The students are given the situation as previously described in this manual. Then a KWL is started by having the students establish what they know, not only from the given situation but also from their own knowledge. The "W" part helps the students form what they must discover in the process of inquiry in order to solve the situation. Finally, the "L" not only closes the activity but becomes part of the "K" for a continuing series of inquiry.

RELEVANCE TREE

The relevance tree resembles a flow chart of connected ideas. In this activity, a term or idea is stated and the students are asked to make connections to the previous idea given. When a sufficient number of ideas are listed, a connection is made between the first and the last idea. In the sample given, Professional baseball is connected to Little League baseball through the sequence of ideas given.

Professional baseball
stadium
people
bats
balls
kids
Little League baseball

This again can be used when there is a need to generate ideas about a particular topic in order to continue the inquiry thought.

FUTURE WHEEL

Future Wheel is an activity in which the students are asked to expand their thinking about a particular topic, in this case, prohibition. The topic is given center position on a paper. Then the students make relational statements about the future positive aspects of the topic and the possible negative aspects of the topic.

The activity, when used with inquiry, allows for the expansion of discovered ideas into other domains.

negative negative

positive positive

prohibition

negative negative

positive positive

Q-SPACE

Q-Space was developed by the consulting team of Hanson, Silver, and Strong (1980) to incorporate good teacher actions while questioning students. Their premise is that questioning leads to one answer while QUESTING leads to further thought. In Q-Space, the teacher uses a variety of actions to further this thought.

S - silence and wait time. By waiting 5-10 seconds between question and answer, the student's thinking is increased.

P - probing. Asking certain questions such as "What was your thinking on that?" probes deeper into the thinking.

A - accepting. The way the answer is accepted determines what further answers will be given. Saying "That is wrong" may stop further thought, while saying "30 is the answer for 5 x 6; now what would be the answer for my question of 5 x 7?"

C - clarifying. The teacher helps clarify the answer for the giving student or other students. Words such as "I hear you saying ..." are used.

E - elaborating. Asking the students "What if ..." type questions even after they have answered the original question correctly furthers students' thinking.

LEARNING LOGS

These come under a variety of names also but all have the same basic component. After the initial situation is given in an inquiry lesson, there is a need for the students to collect data and form hypotheses on the situation. Using a "log" can be very helpful. The log can be simply a piece of paper or a notebook which will be used throughout the year. With this log, the students can hear the story, write down their thoughts, and review them before the class as a whole is asked to respond.

When used with the THINK-PAIR-SHARE techniques of Cooperative Learning, the log becomes a powerful means of getting everyone involved in the thinking and sharing of their ideas. The log can also become a developmental record of the student's thought from the beginning of the inquiry lessons to the end.

COOPERATIVE LEARNING

Cooperative Learning is a philosophy of teaching which places students in learning teams to accomplish a group task. It has recently received publicity through educational and lay journals. It deserves the highlighting since research has shown it to increase student learning, interest and team cooperation.

For Inquiry, the use of Cooperative Learning strategies is not only very appropriate, it is sometimes vital in order to insure complete student participation and success. The easiest strategy to implement is THINK-PAIR-SHARE. In this action, the teacher presents a question and the students think about the answer, either silently or by writing down their ideas in the learning logs. Then the teacher asks pairs of students to share their answers and perhaps to come up with some common ideas. Finally, the students are asked to shares in a large group. The benefits of THINK-PAIR-SHARE are that each student has had his/her answer heard by at least one person, the ideas are "tested" with a partner before being discussed in a large group and everyone has a chance to formulate their ideas before being asked to answer.

Group task assignments are an integral part of cooperative learning and inquiry. To enhance the problem-solving aspects of inquiry, a task is given to the group to solve which would add to the total problem in the inquiry lesson. Assign in each group of three to four a chairperson, a recorder, a facilitator, and an assistant. Variations on the theme of simply solving the immediate task could be to have the recorders confer.

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DESIGNING

THE LESSON

DESIGNING

THE LESSON

SITUATION

DATA

HYPOTHESES

TESTS

REVIEW